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ARTICLE

Temporality and Belonging as Transdisciplinary Phenomena: Strategic Encounters between Queer Theory and Population Genetic Technologies

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Abstract

This article asks how to study evasive and seemingly immaterial transdisciplinary phenomena such as affective formations that organize our technoscientific societies and cultures. I argue that understanding such phenomena requires developing methodologies that engage fields of knowledge production that appear unrelated. The article uses the dynamics of temporality and belonging underlying population genetics as a case study. I show how two seemingly incompatible fields of knowledge production—queer theorization of temporality and population genetic technologies and practices—can together engender new insights on how temporality and belonging organize population genetic knowledge. I argue that neither field of knowledge production could achieve such insight alone; instead, insight emerges from the unexpected resonances as well as friction between the two fields. I develop this argument through an analysis of the configurations of temporality and belonging on the Genographic Project website.

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As feminist science and technology studies (STS) scholars, we typically explore phenomena that are located between conventional academic disciplines. The phenomena we study are transdisciplinary in the sense that we need to interrogate their material, technological, cultural, and social dimensions in order to understand how they operate in technoscientific societies and shape our lives (e.g., Haraway, 1991; Lykke, 2004). For example, pregnancy, infertility treatments, chronic illness, and implantable medical devices are embodied phenomena that bring together molecular, hormonal, technological, emotional, discursive, and epistemic processes, as feminist scholars have shown (e.g., Hird, 2007; Meskus, 2015; Thompson, 2005; Oudshoorn, 2015).

This article provides a new perspective to the question of how to study transdisciplinary phenomena. My starting point is the observation that feminist STS scholars often engage with transdisciplinary phenomena that have a materially grounded empirical referent: for example, how a particular technology is developed, used, experienced, or represented. Such phenomena may be ambiguous or multiple, as Annemarie Mol's (2002) exploration of the vascular disease atherosclerosis and Charis Thompson's (2005) analysis of ontological choreography at infertility clinics show. I am interested, however, in what happens when the object of study is an affective formation—for example, nostalgia or belonging—that lacks a material referent. While such a phenomenon often emerges through, or is articulated in relation to, material practices, the phenomenon itself is largely immaterial and evasive. I want to emphasize that such phenomena differ from more clearly material phenomena *in degree rather than in kind*. That is, I am not suggesting a distinction between two kinds of transdisciplinary phenomena. Rather, I want to explore what happens when the idea of transdisciplinary phenomena is applied to an affective formation that underlies and organizes technoscientific society and culture. The motivation for the article arises from my engagement with cultural studies, especially questions of belonging, temporality, nostalgia, and the circulation of emotions around biotechnologies.

The primary focus of my article is methodological. The article is centered on the question: *How can we investigate an evasive and largely immaterial phenomenon such as an affective formation in a way that accounts for its cultural as well as bioscientific entanglements?* I argue that an analysis of affective formations benefits from strategic encounters between fields of study usually considered distinct or even incompatible. I develop this argument through a specific case study: the affective formations of temporality and belonging as they take shape around the discourses and technologies of human population genetics. I approach temporality and belonging through queer theorization of time and population genetic practices, two fields of knowledge production seldom explored together. Such a strategic engagement refuses to render population genetics a mere object of queer analysis, seeing it instead as an active mode of knowledge production, while also acknowledging the potentiality of queer theoretical approaches as methods of studying practices conventionally understood as bioscientific. This kind of strategic engagement resonates with Karen Barad's (2007) "diffractive methodology," in which approaches or fields of study engage in an open and nonhierarchical co-production of phenomena. Yet my analysis is not an application of Barad's methodology, but rather addresses the specific concerns involved in the study of affective formations. My article contributes to the goal of this special issue to think feminist theory as science by exploring the *co-production of knowledge* by queer theory and population genetic practices. This kind of co-production engenders both resonances and friction. The article suggests that it is precisely through such moments of recognition and departure that new insights may arise.

In what follows, I trace how population genetic configurations of temporality and belonging articulate and reshape cultural conceptions of time and, at the same time, how temporality and belonging emerge through population genetic practices. Temporality and its social configuration, belonging, underlie both population genetics and queer theory in crucial ways. Population genetics explores how DNA records

the passage of evolutionary time and the movement of populations across the globe. It metaphorizes genetic material as a “molecular clock” that measures the temporal distance between populations through the gradual accumulation of mutations. In such a framework, genetic differences are seen as organized by temporality. Temporality also plays a key role in queer theory, though seldom in the context of biotechnologies. Queer-studies scholars have challenged the persistence of cultural conceptions of time as linear and future-oriented and envisioned alternative ways of approaching temporality. These studies have often focused on the disjuncture between embodied experiences and normative conceptions of historical time and the proper organization of life events related to marriage, reproduction, and ideas of maturity. In both population genetics and queer theory, temporality is closely connected to *belonging*, understood here as a temporal dynamic through which people and communities emerge as connected to culturally meaningful historical trajectories. For example, population genetic practices such as genetic diversity projects or commercial genetic ancestry tests refashion ideas of kinship and identity in foundational ways (e.g., Hamilton, 2012; Hinterberger, 2012; Nash, 2005, 2012; Skinner, 2006; TallBear, 2013a, 2013b; Wald, 2006). Similarly, queer explorations of time have highlighted the connections between past, present, and future marginalized communities and subjectivities, as well as theorized the affective structures of the present (e.g., Boellstorff, 2007; Dinshaw, 2007; Freeman, 2010; Halberstam, 2005; Muñoz, 2009; Povinelli, 2011).

The first two sections of the article provide a brief overview of temporality in population genetics and queer theory. The following sections turn to the website of the Genographic Project, the National Geographic Society’s ambitious initiative of studying human genetic variation, through which I develop my analysis of temporality as materially and technologically enacted. Through the critical lenses of queer theory, I examine how gender and sexuality underlie the ways in which the Genographic Project invokes and refashions temporality and belonging. At the same time, I complicate queer insights on temporality through the

material and technological situatedness of population genetic practices, especially the differences between mitochondrial, Y-chromosome, and admixture analyses. Through this two-way approach, I demonstrate how temporality and belonging are always connected to specific uses of technology. I propose that bringing queer theory and population genetic technologies into a strategic encounter may help us understand not only how temporality is gendered and sexualized, but also how those processes of gendering and sexualizing are inseparable from the materiality of technologies and their underlying epistemic premises.¹ Based on my analysis, I suggest that temporality and belonging benefit from an approach that engages in and brings together diverse and even incongruous fields of inquiry.

Temporality in Population Genetics

Human population genetics seeks to identify genetic differences between past and present human populations and to construct evolutionary trees that document the prehistoric divergence of human populations on the basis of these differences. For a significant part of its history, population genetics has been interested in genetic variation in noncoding DNA: that is, in markers that do not directly control the physiology of the organism and are therefore not subject to natural selection in the same way as coding DNA. As changes in noncoding DNA generally result from random mutations, which often accumulate at a predictable rate, differences in noncoding DNA can be used to evaluate the evolutionary distance between populations. This understanding of differences builds on the concept of the “molecular clock” developed in the 1960s.² The molecular clock is based on the premise that the more mutations there are between two populations, the earlier in human evolution those populations diverged. At the same time, genetic diversity within a population suggests old age; for example, the great genetic diversity within African populations is commonly seen as evidence that anatomically modern humans first appeared in Africa and that other populations are descended from smaller groups that migrated from Africa. Crucially, this model of

genetic variation understands genetic differences as organized by temporality: differences are both the result of and evidence for the passage of evolutionary time.

Human population geneticists have focused on various types of genetic material. One of the early breakthroughs was the use of mitochondrial DNA (mtDNA) to evaluate the genetic relatedness of populations in the late 1980s (Cann, Stoneking, & Wilson, 1987; Vigilant, Stoneking, Harpending, Hawkes, & Wilson, 1991). Located outside the cell nucleus, mitochondria carry their own specific DNA unrelated to the DNA stored in the chromosomes in the cell nucleus. There were several practical reasons why mtDNA analysis was feasible before other types of genetic analysis: mtDNA mutates fast, it is concise compared to nuclear DNA, and it exists in multiple copies in the cell. It is also inherited from only one parent, the mother, which means that it is not subject to recombination, the mixing of genetic material in sexual reproduction. This uniparental inheritance renders the evolutionary trajectories constructed through mtDNA strictly maternal, and thus less complicated than the biparental dynamics of recombination underlying most nuclear DNA. In the 1990s, advances in sequencing techniques led scientists to analyze another type of genetic material: a noncoding and nonrecombining section of the Y-chromosome (Hammer, 1995; Whitfield, Sulston, & Goodfellow, 1995). Passed from father to son, Y-chromosome DNA (Y-DNA) rendered evolutionary history strictly paternal. Y-DNA analysis was seen by many as a parallel (and, in some accounts, a corrective) to the maternal focus of mtDNA analysis (Oikkonen, 2015a). This resulted in human evolution increasingly being conceived through two gendered reproductive trajectories.

In the past ten years, fast developments in sequencing technologies have reshaped the temporal investments of population genetics. First, the feasibility of genome-wide analysis of genetic inheritance has complicated the patterns of evolution previously constructed through the uniparental inheritance of mtDNA and Y-DNA. Genome-wide techniques have enabled scientists to better understand

the evolutionary processes that produced modern human genomes. As a result, evolution increasingly appears as a complicated process in which genetic material is constantly mixed and reshuffled through sexual reproduction and the intertwining patterns of prehistoric migration. Yet the direction of evolutionary movement is forward, from an evolutionary past to an unfolding future. Second, population genetic analysis has focused on smaller population units, on the one hand, and interspecies connections, on the other. While the explorations of mtDNA ancestry in the late 1980s and early 1990s focused on large world populations, such as “African” or “East Asian,” scientists have increasingly turned to specific haplogroups characterized by specific mutations. This has shifted the focus to the divergence of population groups in the past 20,000 years. At the same time, technological development has enabled the analysis of DNA retrieved from ancient hominin remains such as Neanderthals or Denisovans. This has expanded the temporal scope backward, situating the evolution of modern humans in the context of the diverging trajectories of hominin species. These developments have rewritten evolutionary temporality as both more specific and more encompassing than previously envisioned. In the process, the affective appeal of evolutionary history as a means of enacting roots and belonging in contemporary culture has strengthened.

Queering Time

The idea of temporality as a future-oriented procession has been critiqued by queer-studies scholars, especially in the past fifteen years. Queer explorations of time have typically focused on the intertwining of temporality and sexuality. In so doing, they have touched on three issues also central to the working of population genetics: linearity, futurity, and the affective structures of the present.

The first issue concerns the hegemonic understanding of time as linear and progressive. This “straight time” organizes personal lives through symbolically charged events such as birth, marriage, and

reproduction or perceived periods such as childhood, the teenage years, responsible middle age, and harmonious old age. This personal timescale is connected to the societal level, as institutional forces “link properly temporalized bodies to narratives of movement and change” (Freeman, 2010, p. 4) so that “people are bound to one another, engrouped, made to feel coherently collective, through particular orchestrations of time” (Freeman, 2010, p. 3). This suggests that “straight time is an emically salient, socially efficacious, and experientially real cultural construction of temporality across a wide range of political and social positions” that is “shaped by linked discourses of heteronormativity, capitalism, modernity, and apocalypse” (Boellstorff, 2007, p. 228). However, nonnormative experiences may be organized by alternative, queer configurations of time. According to Jack Halberstam, queer time may be embodied in “the dark nightclub, the perverse turn away from the narrative coherence” of expected life events (Dinshaw et al., 2007, p. 182). It may also show, as Elizabeth Freeman notes, in “nonsequential forms of time” that “fold subjects into structures of belonging and duration that may be invisible to the historicist eye” (Freeman, 2010, p. xi).

The second issue centers on the relationship between queerness and forward movement toward a future. According to Lee Edelman (2004), the very idea of futurity is incompatible with queer politics. If society is organized by “reproductive futurity” that posits reproduction as a promise of continuity, then “the queer comes to figure the bar to every realization of futurity, the resistance, internal to the social, to every social structure of form” (Edelman, 2004, p. 4). Edelman critiques attempts to save queerness from the margins of reproductive futurity and argues that queers should embrace negativity and refuse futurity. Scholars like José Esteban Muñoz and Elizabeth Povinelli, by contrast, have theorized the possibility of alternative futures. According to Muñoz, queerness is “essentially about the rejection of a here and now and an insistence on potentiality or concrete possibility for another world” (2009, p. 1). Povinelli, too, theorizes “the conditions in which new forms of social life emerge” (2011, p. 5), focusing on “the virtual space that opens up

between the potentiality and actuality of an alternative social project” (p. 8).

The third question concerns the nature of the present moment as part of history. Carolyn Dinshaw (2007) has explored the intricate temporal connections between communities and individuals across historical time. She focuses on experiences of anachronism, “of time falling outside” the temporal organization of historical processes (2007, p. 111). Dinshaw identifies “an expanded present, a temporally multiple now” (p. 112), which enables “a sense of simultaneous belonging to one’s own time as well as to other times” (p. 119). Lauren Berlant, in turn, has analyzed the affective structures of the present. For her, “the present is perceived, first, affectively” before it becomes a series of events that can be narrated as part of historical processes (2011, p. 4). How we understand the present as an affective and temporal state structures how we orient ourselves toward the past and the future and how experiences become part of the passage of historical time. As I hope to show in the following sections, these critical engagements with temporality can shed new light on the temporal dynamics underlying population genetics while also gaining new depth through encounters with population genetic practices.

The Genographic Project as a Temporal Endeavor

The Genographic Project is a large genetic diversity initiative launched by the National Geographic Society in 2005. The project seeks to study the evolution of human genetic diversity by focusing on the genetic makeup of indigenous populations. The project also runs an online genetic ancestry testing service through which any of us (willing to pay 150 US dollars) can test our place in human evolution, or what the website calls “The Human Story” (Genographic Project, 2016a). In many ways, the Genographic Project is a continuation of the ill-fated Human Genome Diversity Project (HGDP), which was proposed with fanfare in the early 1990s but quickly came under heavy criticism by bioethicists and

indigenous organizations.³ While the HGDP was accused of appropriating indigenous DNA for the benefit of non-indigenous communities, the Genographic Project has declared itself to be “anonymous, nonmedical, and nonprofit” (Genographic Project, 2016b). Nevertheless, the unresolved issues about racial differences that underlay the HGDP—how to study genetic differences between populations without reinforcing the idea of race?—continue to inform the Genographic Project (TallBear, 2007; Wald, 2006).⁴

A number of scholars have critically explored the role of race and conceptions of indigeneity in the Genographic Project. For example, Catherine Nash (2012) explores how racialized differences are produced through assumptions about geography and human mobility in the project, Jenny Reardon and Kim TallBear (2012) analyze its reliance on assumptions of ownership over indigenous genetic material, and Priscilla Wald (2006) shows how it employs colonial rhetoric that posits indigenous people as locked in the past. While inspired by these inquiries into the racialized politics of the Genographic Project, my article focuses on how population genetics mobilizes heteronormative assumptions of being and belonging. The article uses an encounter between queer theory and population genetic practices as a case study to explore how to study affective formations as transdisciplinary phenomena. A more detailed exploration of the affective formations underlying population genetics would benefit from integrating postcolonial and other critical theorizations of temporality into the analysis as well.

In what follows, I use the Genographic Project’s official website as an entry point to the analytical practices, material circumstances, and cultural discourses that underlie population genetic configurations of temporality and belonging. Although the website is first and foremost a discursive space, it relies on a set of biotechnological practices. It also operates as an apparatus through which genetic tests are sold and justified and test results interpreted and given meaning. The discursive aspects of the website are thus entangled with the materiality of DNA samples, genetic technologies, DNA databases, and the exchange of

money and services on the website.

The Genographic Project's website opens with an introduction that clearly states the temporal stakes of the project:

Since its launch in 2005, National Geographic's Genographic Project has used advanced DNA analysis and worked with indigenous communities to help answer fundamental questions about where humans originated and how we came to populate the Earth. Now, cutting-edge technology is enabling us to shine a powerful *new* light on our collective past. By participating in the latest phase of this real-time scientific project, you can learn more about yourself than you ever thought possible. (Genographic Project, 2016a; emphasis in original)

The passage portrays the population genetic enterprise as progressive and future-oriented through phrases such as *advanced DNA analysis*, *cutting-edge technology*, and *latest phase*. This future orientation of biotechnology is contrasted with the past-oriented gaze it provides as the project peers into what is portrayed as a "collective past." Between these two temporal orientations emerges a temporal trajectory characterized by a chain of evolutionary transitions through which "we came to populate the Earth" (and, eventually, to ask questions about our ancestry). On the one hand, this framing casts evolution as a progressive and foundational trajectory that reflects the linear and future-oriented logic of "straight time" theorized by queer scholars like Boellstorff, Freeman, Edelman, and Halberstam: that is, the framing is marked by a sense of time as momentous, unswerving, incontestable, and totalizing. On the other hand, the temporal trajectory is characterized by ambivalence, as when the website states, "You will discover the migration paths your ancient ancestors followed thousands of years ago," thereby casting the future-oriented promise of "will discover" against the past-oriented insistence on the primacy of the ancestral "migration paths" (Genographic Project, 2016b). These two tendencies suggest a multidirectional temporality in which the past, present, and future are defined through one another. Interestingly, this underlying multidirectionality resonates with the

complicated relations between what has been and what will be addressed by scholars like Freeman, Povinelli, or Muñoz in the context of sexuality, experience, and societal change. This does not mean that the two temporal arrangements concur; rather, their resonances suggest that the mutual embeddedness of the past, present, and future in population genetics and in processes of societal change are part of larger temporal tendencies that underlie culture.

The multidirectional temporality constructed on the website renders the present moment an affective space in which the possibility of futurity is imagined. First, the present is given a sense of urgency by encouraging the readers to “take part in a *real-time* research project” by contributing their DNA-test results to “the larger community” of Genographic Project participants (Genographic Project, 2016b; emphasis mine). This description posits the Genographic Project as attuned to the unceasing forward movement that is assumed to characterize the present. It also places the implied reader as the temporally organized subject through whom the presumably collective striving for futurity takes shape. This resonates with Berlant’s (2011) observation that the present holds a precarious position as part of the procession of historical time and yet as the moment at which the future still appears as open. Second, this multidirectional temporality coincides with the life course of the prospective reader through the description of the Genographic Project’s genetic testing service. “Welcome to the expedition of a lifetime,” the website declares (Genographic Project, 2016b). This parallelism between evolutionary time and individual life reflects the mutual embeddedness of historical, national, and personal temporalities analyzed by Boellstorff, Halberstam, and Freeman. Like evolutionary temporality, the temporality of the individual life invoked on the website is distinctly future-oriented, as suggested by the promise that the readers will continue to learn about genetic history after receiving the test results. “Your results are just the beginning,” the website explains. “It’s like having a subscription to your very own genetic history—and to the history of all of us” (2016b).

These resonances and parallelisms between the rhetoric of the

Genographic Project and queer analyses of temporality suggest that queer theory may engender important insights on how biotechnologies are entangled with cultural assumptions about futurity and the potentialities of the present. Queer theory may operate as a useful analytical lens to the larger affective structures within which scientific projects appear as appealing or urgent. At the same time, as I shall argue next, these affinities indicate that paying attention to the material specificities of biotechnological configurations of time is crucial to understanding the complexities of temporality and belonging.

Specific Technologies, Specific Temporalities

To show further possibilities inherent in encounters between queer theory and population genetics, I turn to the specific testing practices employed by the Genographic Project. The Genographic Project website markets a genetic ancestry testing kit called Geno 2.0 Next Generation. The test uses a DNA chip that analyzes three types of genetic inheritance—mtDNA, Y-DNA, and admixture—covering altogether close to 750,000 genetic markers.⁵ While mtDNA and Y-DNA components trace maternal and paternal lineages, the admixture test seeks to determine the percentage of (tested) genetic markers the test-taker shares with populations from different continents or with the prehistoric Neanderthals.⁶ Geno 2.0 thus provides three visions of belonging. The admixture test grounds belonging in the similarities between what are imagined to be clearly defined populations.⁷ The appeal of such tests often resides in their ability to surprise: for example, to tell an ethnically white North American that 5 percent of her genetic material is African or Native American. Underlying the test is the assumption that all humans are connected through the steady procession of evolution. At the same time, mtDNA and Y-DNA tests encourage test-takers to interpret belonging as an exclusive maternal or paternal continuum. As the mtDNA and Y-DNA tests highlight the (imagined) purity of the traced maternal and paternal lineages, temporality acquires a sense of geographic

specificity: it appears as a unique trajectory leading from a localized point in the past to a localized present. Furthermore, while all three tests build on the mutual embeddedness of the past, present, and future explored above, they orient differently within this temporal dynamic. The admixture test addresses the complexities of the present by comparing populations, whereas the mtDNA and Y-DNA tests reach toward a strictly gendered past in order to explain the present.

These differences between mtDNA, Y-DNA, and admixture components of the kit challenge the popular assumption that genetics engenders a uniform idea of belonging as biologically grounded. Instead, belonging emerges as *ontologically multiple*, thus reflecting Annemarie Mol's (2002) insightful observation that technoscientific phenomena are often ontologically more complicated and heterogeneous than they may first appear. My analysis approaches ontological multiplicity primarily as an *outcome* of material conditions and the use of technologies. That is, the affective dynamics of temporality and belonging emerge as multiple because of the diverse techniques and practices mobilized in the Geographic Project. Each of the three tests manipulates specific biological material—particular genetic markers—in order to produce differences and similarities between people. This material, in turn, is derived from tissue, blood, or saliva samples or cultured cell lines used in population genetic research. It is also often circulated between research labs. Indeed, Amade M'charek notes (2005, 2014) that the choice of material in scientific study depends on the availability of samples, which is often limited by geographic distance, institutional policies, or personal networks. Furthermore, the development of computer programs to process ever larger sets of data affects the shapes that temporality and belonging take in population genetics. The size and type of the genetic database also plays a crucial role, as genetic ancestries are produced through comparisons to other samples.

Yet the Genographic website erases the materiality of the genetic technologies it markets and deploys: the differences between the three technologies, and their reconfigurations of temporality and belonging,

disappear under the language of kinship. This takes place through the metaphor of “the human family tree,” the genealogical tree of relatedness on whose “branches” we are each located (Genographic Project, 2016b). This familial and organic rhetoric masks how different modes of genetic analysis enact different configurations of temporality and belonging. Instead, the website invokes an image of “our shared migratory history” (Genographic Project, 2016e), as if there was one monolithic, uniform, and indisputable movement in time that engulfed the myriad complicated molecular realities that characterize our personal genetic histories. The human family tree also foregrounds heterosexual reproduction. This reproductive emphasis is both literal and symbolic, as it emphasizes the material transmission of genetic markers across generations as well as the culturally sanctioned position of the heterosexual couple as a unit of reproduction. However, the multiple technologies that underlie the Genographic Project suggest that reproduction, too, is multiple. This is where engagement with queer studies again provides important insights.

Reproduction and Population Genetic Belonging

Although queer and feminist scholars have explored assumptions of innate gender and sexual characteristics in behavioral genetics and evolutionary psychology (e.g., Lancaster, 2003; Oikkonen, 2013; O’Riordan, 2012; Roof, 2007), there has been much less interest in population genetics, which has been seen as primarily engaged with racialized differences.⁸ Yet population genetic knowledge is organized by sexuality, as reproduction is the mechanism through which genetic markers are passed on through generations. That is, temporality and belonging are structured through specific arrangements of reproduction over evolutionary history. This is the case with the three modes of testing included in Geno 2.0, as they each mobilize a slightly different reproductive dynamic. While the admixture test highlights reproduction, it does not depend on a specific reproductive tie, because individual genomes are seen as connected to populations through myriad

intersecting reproductive ties or molecular likenesses. MtDNA and Y-DNA tests, by contrast, seek to detect a specific gendered chain of reproduction: purely maternal and purely paternal inheritance. While all three tests foreground reproduction and exclude nonreproductive ties (for example, communal and political affiliations), there is no single dynamic of “genetic reproduction” but multiple configurations of reproductive continuity. What counts as reproduction in one test does not count as reproduction in the others: for example, sex resulting in female offspring is not reproduction in Y-DNA tests, while sex resulting in male offspring is not reproduction in mtDNA tests.

As was the case with the multiple configurations of temporality and belonging, the different dynamics of reproduction that underlie Geno 2.0 are also largely erased or trivialized. The Genographic website highlights the apparent inclusiveness of the Genographic Project: “How did *each of us* end up where we are?” it asks (Genographic Project, 2016d; emphasis added), while emphasizing that the project involves as many as “75,000 indigenous and traditional participants” and “more than 640,000 public participants” (Genographic Project, 2016e). Yet the mtDNA and Y-DNA techniques leave out a large number of genetic lineages that cross the gender line, such as a lineage that runs, say, through mother, grandfather, great-grandmother, and great-great-grandfather. These erasures undermine the website’s promise to help test-takers “connect with others around the world who share your deep ancestry,” as “shared ancestry” refers only to those connections the analytical techniques are designed to track (Genographic Project, 2016b). Furthermore, the project cannot tell us anything about sexual unions or affiliations that do not result in reproduction. Thus it leaves out an array of sexual arrangements that organize communities.

These exclusions underlie the temporalities that emerge on the website. Most importantly, the temporal multiplicity inherent in the testing technologies is made to appear as longing for reproductive continuity. This is where queer theorization of temporality provides an important analytical perspective. Viewed from a queer-studies angle, population

genetics appears as an epitome of the “reproductive futurity” Edelman critiques, as it is only through reproduction that the chaotic temporalities of the past, present, and future constitute a culturally meaningful trajectory that promises futurity. Furthermore, the configurations of reproduction in mtDNA, Y-DNA, and admixture tests reinforce the assumption, critiqued by Freeman and Halberstam, that life events centering on heterosexual courtship and the birth of offspring signify proper passage of time. While the website promises that prospective customers will be “helping us fill in the gaps in the human story,” the website’s narrative of evolution is premised on another set of gaps—the omission of nonreproductive ties—that, if included, could challenge the very idea of a linear, future-oriented temporality (Genographic Project, 2016c). At the same time, attention to the specific effects of techniques and technologies is also required: reproductive futurity relies on success in passing on specific molecular material (i.e., having a girl, in the case of mtDNA, or having a boy, in the case of Y-DNA). The material available for analysis also plays a role, as different samples, sets of comparative data, and computer programs lead to different forms of reproductive futurity, engendering slightly different connections between past, present, and future individuals and communities.

The appearance of reproductive futurity through testing technologies also touches on another concern central to queer studies: the shape and potentialities of the present. Alondra Nelson (2008) and David Skinner (2006) have argued that cultural fascination surrounding genetic ancestry tests arises largely from the affective possibilities of negotiating identities in the present. The Genographic Project website (2016c) appeals to the reader’s affective present by declaring that Geno 2.0 will help the reader to “learn more about yourself than you ever thought possible.” The “you” invoked here, however, is a strictly curtailed subjectivity that falls neatly within the reproductive continuum of evolutionary history. The desire to “learn more” is also defined through this reproductive temporality, with the result that the limits of “possible” knowledge remain narrow. While the present emerges as a site of

longing, it opens only into directions defined through reproduction. This suggests that the reproductive underpinnings of population genetic temporalities posit people differently as affectively engaged subjects. In light of the specificities of the three testing technologies, the idea declared on the website that we all belong to the procession of evolution in similar and equal ways is misleading.

I have shown that both a queer reading of the reproductive assumptions organizing temporality, and the specific materialities of testing technologies, play a crucial role in producing this analysis of temporality and belonging. In other words, it could not have been achieved without strategic encounters between queer theorization of time and an exploration of the material practices of genetic testing.

Conclusion

This article set out to examine affective dynamics that underlie transdisciplinary technoscientific phenomena. I have argued that bringing together fields of knowledge production usually considered distinct or even incompatible may generate unexpected moments of resonance. While such moments are characterized by friction, it is precisely through these uneasy parallels and connections that unexpected insights emerge. In this case study, the encounter between the material specificity of technological practices and queer approaches to temporality enables me to view population genetic temporality and belonging as materially and technologically grounded, yet entangled with cultural narratives and affective frameworks in complex ways. It allows me to see how, despite the apparent simplicity of belonging on the website, population genetics is characterized by various configurations of temporality, belonging, and reproduction. I have demonstrated that the issues of linearity, futurity, and the affective present, central to queer studies, are at the heart of population genetics as well. In the Genographic Project, genetic belonging is organized by assumptions of unceasing and all-encompassing temporal procession. This logic of movement embeds the

present moment of discovery within an affectively charged historical trajectory that is premised on reproduction. I have also shown that the various population genetic technologies the Genographic Project deploys enact different temporal dynamics and thus different configurations of belonging. This insight could not have been reached only through an account of the technological and material practices of population genetics, nor through a one-way application of queer theorization of temporality to the Genographic website. Instead, a strategic encounter between queer theory and population genetic technologies can provide fresh insights into these underlying complexities—but only when queer theorization is brought into dialogue with, rather than positioned against, the material practices of genetic analysis.

In the strategic encounter between queer theory and population genetic technologies outlined in this article, the two fields of knowledge production become entangled. Understanding how technologies operate enriches queer analysis of temporality by making visible the connection between different configurations of temporality and belonging and material practices. This in turn encourages a close analysis of the sexual and reproductive underpinnings of each of the temporally organized configurations of belonging. At the same time, queer theorization of temporality and belonging draws attention to the affective investments and narratives of inclusion and exclusion that make those technologies appear appealing and timely. One result of this focus on the connection between temporality and technologies is that the politics underlying population genetic knowledge emerge as both more specific and more complicated than is often understood in popular discourses criticizing genetics.

In present analysis, queer theory provides the lens onto the cultural underpinnings of temporality. It is important to note that different theoretical approaches would make visible other aspects of population genetic temporalities. For example, a postcolonial approach might highlight how evolutionary temporality takes shape through geographic space, such as the idea of Africa as the evolutionary origin of humanity

and thus implicitly past-oriented, or of relatively recently populated areas—Greenland, for example—as “too young” to be properly rooted in evolutionary history. It could also highlight how prehistoric migrations operate as a mechanism that produces difference and thereby enables the view of evolution as future-oriented—that is, how the idea of genetic differences between populations is invested in futurity.⁹ At the same time, a critical disability studies approach might render visible ableist undertones in evolutionary discourse, such as assumptions of “fitness” and able-bodiedness in the idea of reproductive success at the heart of accounts of evolutionary continuity. A critical reading of class relations, in turn, might foreground how the individual life course the tests invoke and promise to cherish relies on middle-class ideas of proper ways of arranging personal lives and social relations. Each of these approaches could be brought—alone or together—into a strategic encounter with the specificity of population genetic technologies, and each encounter would turn the studied object—population genetic temporality and belonging—toward a slightly different angle, rendering visible different constellations of temporality, belonging, technology, and materiality.

Finally, the purpose of the transdisciplinary encounter outlined in this article is not to produce a methodological synthesis—indeed, a systematic synthesis would, I believe, reduce the potential insights produced through the encounter. Instead, the methodological crux is precisely in engaging two realms of knowledge production in an unpredefined encounter that seeks to reveal moments of resonance as well as departure. While my focus has been on genetic ancestry testing, the strategic encounters between bioscientific technologies and queer theory (or another critical approach) could be applied to other evasive and seemingly intangible phenomena emerging with technoscience. This would involve approaching the chosen phenomenon as materially and technologically enacted, and as potentially multiple. At the same time, it would involve recognizing differences between the gendered and sexualized (or racialized, ableist, and classed) underpinnings of these multiple configurations.

Notes

¹ I use the word *gender* (instead of *sex*) consciously here, since the evolutionary trajectories and kinship relations that emerge through population genetic practices invoke a range of assumptions about the cultural organization of gender even when they appear to be merely about molecular-level sex.

² The molecular clock was developed by, among others, Emile Zuckerkandl and Linus Pauling (1962), Emanuel Margoliash (1963), Vincent Sarich and Allan Wilson (1967), and Mary-Claire King and Allan Wilson (1975).

³ The first director of the Genographic Project, Spencer Wells, was a former postdoctoral student of Luigi Luca Cavalli-Sforza, one of the key figures behind the HGDP.

⁴ In the wake of the Holocaust and early-twentieth-century eugenics programs, population geneticists have emphasized that race is not a meaningful genetic category and that population genetics provides a way of challenging racism. Nevertheless, population genetic terms like “population” and “haplogroup” refer to genetically related groups that can often be linked to specific geographical areas. See Reardon (2005), who argues that a key reason why the HGDP ran into trouble was its failure to conceptualize human differences in terms clearly distinct from race.

⁵ The Y-DNA test is available only to those who are chromosomally male, i.e. have a Y chromosome.

⁶ These three modes of genetic ancestry testing are used by many online genetic testing businesses, although the specific practices vary. For example, Ancestry by DNA, Family Tree DNA, Roots for Real, and 23andMe market similar tests.

⁷ This assumption of clearly defined populations has been challenged by many STS scholars. See, for example, Hinterberger (2012).

⁸ For an exception, see Nash (2015).

⁹ See Oikkonen 2015b for some examples.

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Bio

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